INDOOR AIR QUALITY ASSESSMENT

Cambridge Peabody Elementary School
44 Linnaean Street
Cambridge, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
Emergency Response/Indoor Air Quality Program
October 2003

Background/Introduction

At the request of a parent, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA), provided assistance and consultation regarding indoor air quality concerns at the Peabody Elementary School (PES), 44 Linnaean Street, Cambridge, Massachusetts.

On June 10, 2003, a visit to conduct an indoor air quality assessment was made to this school by Cory Holmes, an Environmental Analyst in the Emergency Response/Indoor Air Quality (ER/IAQ) program, BEHA. Mr. Holmes was accompanied by Sharon Lee, Environmental Analyst, BEHA, ER/IAQ program; Joseph Lombardo, HVAC technician, Cambridge Public Schools (CPS); and Michael Ginieres, Air Ecology representing the Cambridge Health Department.

The PES is a two-story brick building constructed in 1961. The school contains general classrooms, science classrooms, auditorium, gymnasium, art rooms, kitchen and cafeteria, library and office space. Windows are openable throughout the building.

It is important to note that at the time of this assessment, the PES and its staff were in their final year of occupation of the PES building and were preparing to relocate to a new facility as a result of the Cambridge Public Schools Elementary Consolidation Plan (CPSECP). The plan also includes the relocation of a number of other schools in the district. A copy of the CPSECP fact sheet can be downloaded from the CPS website (CPS, 2003).

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551.

Results

This school houses approximately 425 students in grades K-8, as well as a staff of approximately 40-50. Tests were taken during normal operations at the school and results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were above 800 parts per million of air (ppm) in thirteen of forty areas surveyed, indicating inadequate ventilation in some areas of the school. It is important to note that at the time of the assessment, some classrooms had open windows or were sparsely populated.

Fresh air in classrooms is supplied by a unit ventilator (univent) system (Picture 1). Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building (Picture 2) and return air through an air intake located at the base of each unit (Figure 1). Fresh and return air are mixed, filtered, heated and provided to classrooms through a fresh air diffuser located in the top of the unit. Obstructions to airflow, such as papers and books stored on univents and bookcases and/or carts and desks located in front of univent returns, were seen in a number of classrooms (Picture 1). Univents were found deactivated in classrooms throughout the school. In order for univents to provide fresh air as designed, intakes must remain free of obstructions; importantly these units must remain “on” and allowed to operate while rooms are occupied.

Exhaust vents in classrooms are located in the upper interior wall of coat closets (Picture 4). Classroom air is drawn into the coat closet via the undercut portion of the closet door (Picture 5). The location of the exhaust vents allows easy vent blockage by stored materials. In a number of classrooms, these vents were blocked with books, backpacks, boxes and, in particular, open closet doors. In addition, when coat closet doors remain open, they obstruct airflow into the vent (Picture 4). In order to function properly, these vents must remain free of obstructions.

Restrooms are equipped with ceiling-mounted local exhaust vents. No draw of air was detected from the exhaust vents in first floor girls' and boys' restrooms. This may indicate the system was deactivated or that rooftop motors were not operating.

Classroom 18 was retrofitted with a ceiling-mounted air handling unit (AHU) to provide mechanical ventilation. The AHU is ducted to an air intake on the exterior wall. Installation for the AHU was not complete during the assessment. As a result, no means of mechanical ventilation were available. Ventilation for common areas is provided by AHUs located in the boiler room. Air is distributed via ceiling or wall-mounted diffusers connected to ductwork.

In order to have proper ventilation with a mechanical supply and exhaust system, these systems must be balanced to provide an adequate amount of fresh air while removing stale air from a room. The date of the last balancing of these systems was not available at the time of the assessment. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied.

Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please see Appendix I.

Temperature readings were measured in a range of 72^{o} F to 77^{o} F, which were within the BEHA comfort guidelines. The BEHA recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. In addition, it is difficult to control temperature and maintain comfort without operating the ventilation equipment as designed (e.g. univents deactivated, exhaust vents obstructed).

The relative humidity in the building ranged from 40 to 51 percent, which was within the BEHA recommended comfort range. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. The sensation of dryness and irritation is common in a low relative humidity environment. Humidity is more difficult to control during the winter heating season. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

As previously mentioned, several air handling units (AHUs) for common areas are located in the boiler room. Ductwork connected to AHUs in the boiler room was not airtight and had breaches around seams and joints. In one instance, a ductwork panel was being held in place by duct tape (Picture 6). These breaches can provide a source of boiler room odors and a source for particulate matter to be entrained by the ventilation system and subsequently distributed by the AHUs.

Standing water was also observed on the floor in a number of areas in the boiler room. The source of leakage appeared to be from plumbing valves. Wood and cardboard boxes were on the floor in some areas. Such materials can provide a medium for mold growth, especially with repeated wetting.

Several classrooms contained a number of plants. Plant soil and drip pans can serve as a source of mold growth. Plants and potting soil were found on top of univents in several classrooms. Plants were also noted in standing water, which can become stagnant, producing unpleasant odors. Plants should be located away from the air stream of univents to prevent aerosolization of dirt, pollen or mold. The library contained several aquariums/terrariums, some

of which had rotting food and/or visible mold growth (Picture 7). Aquariums and terrariums should be properly maintained and cleaned to prevent bacterial growth, mold growth, and nuisance odors.

In several classrooms, spaces between the sink countertop and backsplash were noted. Improper drainage or sink overflow could lead to water penetration of countertop wood, the cabinet interior and areas behind cabinets. Like other porous materials, if these materials become wet repeatedly they can provide a medium for mold growth.

Exterior caulking around wall panels and univent air intakes on the exterior of the building was crumbling/damaged in a number of areas indicating that the seal is no longer intact (Pictures 8 & 9). These breaches in the building envelope can provide a means of water penetration. Large wall cracks may also provide a means of egress for pests/rodents into the building.

Also of interest are the weep holes along the base of the courtyard brick walls. Weep holes were systematically sealed to prevent rodent infiltration (Picture 10). In order to allow for water to drain from the exterior brick wall system, a series of weep holes is customarily installed at or near the foundation slab/exterior wall system junction (Figure 2). Weep holes allow for accumulated water to drain from a wall system (Dalzell, 1955). Failure to install weep holes in brickwork or burial of weep holes below grade can allow water to accumulate in the base of walls, resulting in seepage and possible moistening of building components (Figure 3). While sealed weep holes may prevent rodent infestation, the sealing could also result in water infiltration.

Trees and other plants were also seen growing in the tarmac/exterior wall junction (Picture 11). The growth of roots against the exterior of foundation, as well as spaces between

the tarmac, can bring moisture in contact with brick and foundation walls, which may eventually lead to moisture penetration below ground.

Other Concerns

Several other conditions that can potentially affect indoor air quality were identified. Damaged pipe insulation was observed behind a loose wall panel in classroom 18 and on an overhead pipe in the art room (Pictures 12 & 13). The pipe insulation may contain asbestos. Upon discovery, these findings were reported to Mr. Lombardo. BEHA staff recommended that the material be encapsulated by a licensed member of the Cambridge Public Schools maintenance staff or other professional contractor as soon as practicable.

In an effort to reduce noise from sliding chairs, tennis balls had been sliced open and placed on chair legs (Picture 14). Tennis balls are made of a number of materials that are a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and lead to off-gassing of VOCs. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as Appendix II (NIOSH, 1998).

CPS officials reported that the building has had problems with mice. During a perimeter inspection of the courtyard Mr. Ginieres identified a decaying mouse on/about the fresh air intake (Picture 2). No odors associated with decaying organic material were detected during the assessment or reported by occupants of this classroom. As a result of materials present in

wastes, rodent infestation can produce indoor air quality related symptoms. Mouse urine is known to contain a protein that is a known sensitizer (US EPA, 1992). A sensitizer is a material that can produce symptoms in exposed individuals (e.g. running nose or skin rashes). A three-step approach is necessary to eliminate rodent infestation:

1. Removal of the rodents;
2. Cleaning of waste products from the interior of the building; and
3. Reduction/elimination of pathways/food sources that are attracting rodents.

To eliminate opportunities for exposure to allergens, rodents must be removed from the building. Please note that removal, even after cleaning, may not provide immediate relief since allergens can persist in the interior for several months after rodents are eliminated (Burge, 1995). A combination of cleaning and increasing of ventilation and filtration should serve to reduce rodent associated allergens once the infestation is eliminated.

Also of note was the amount of materials stored inside classrooms. In classrooms throughout the school, items were observed on windowsills, tabletops, counters, bookcases and desks. The large number of items stored in classrooms provide a source for dusts to accumulate. These items, (e.g. papers, folders, boxes) make it difficult for custodial staff to clean. Dust can be irritating to eyes, nose and respiratory tract. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up.

Accumulated chalk dust and dry erase board particulate was noted in several classrooms. Several rooms had missing and/or dislodged ceiling tiles. Missing/dislodged ceiling tiles can provide a pathway for the movement of drafts, dusts and particulate matter between rooms and floors. Chalk dust and dry erase board particulates can be easily aerosolized and serve as eye and respiratory irritants. In addition, materials such as dry erase markers and dry erase board

cleaners may contain VOCs (e.g., methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999), which can also be irritating to the eyes, nose and throat.

A number of univents had accumulated dirt, dust and debris within the air handling chambers. These conditions can be attributed to the fact that they were not operating, which allows airborne particulates to settle within the units. In order to avoid this equipment serving as a source of aerosolized particulates, the air handling sections of the univents should be regularly cleaned (e.g. during regular filter changes).

Several areas contained window-mounted air conditioners. This equipment is normally equipped with filters, which should be cleaned or changed as per the manufacturer's instructions to avoid the build up and re-aerosolization of dirt, dust and particulate matter.

As mentioned previously, mechanical exhaust ventilation in a number of restrooms was not functioning during the assessment. Exhaust ventilation is necessary in restrooms to remove moisture and to prevent restroom odors from penetrating into adjacent areas.

The faculty workroom had photocopiers and lamination machines. Lamination machines can produce irritating odors during use. VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, 1992). The workroom is located in a former laboratory equipped with an exhaust hood (Picture 15). The exhaust hood was activated and was providing local exhaust ventilation to remove excess heat and odors from the room.

Finally, cleaning products were found on countertops and beneath sinks in a number of classrooms (Picture 16). Cleaning products contain chemicals, which can be irritating to the eyes, nose and throat.

Conclusions/Recommendations

In view of the findings at the time of the inspection, the following recommendations are made:

1. Ensure exposed/damaged pipe insulation material in classroom 18 and art room is encapsulated/remediated in conformance with all applicable Massachusetts' laws.
2. Ensure univent fresh air intakes are free of mouse carcasses. Clean and disinfect univent fresh air intake in Picture 2 with an appropriate antimicrobial.
3. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers throughout the school.
4. To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy independent of classroom thermostat control.
5. Inspect exhaust motors and belts for proper function. Repair and replace as necessary.
6. Reactivate exhaust ventilation in restrooms to remove odors and moisture.
7. Remove all blockages from univents and exhaust vents to ensure adequate airflow.
8. Ensure coat closet doors are closed to allow exhaust vents to operate.
9. Continue with installation of the AHU in classroom 18.
10. Consult a ventilation engineer concerning re-balancing of the ventilation systems. Ventilation industrial standards recommend that mechanical ventilation systems be balanced every five years (SMACNA, 1994).

11. Adopt scrupulous cleaning practices. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
12. Determine and remediate source of leakage in the boiler room.
13. Discard water damaged/mold colonized materials.
14. Seal all seams/breaches in ductwork on AHUs in the boiler room.
15. Move plants away from univents in classrooms. Avoid over-watering and examine drip pans periodically for mold growth. Disinfect with an appropriate antimicrobial where necessary.
16. Seal/replace caulking around univent fresh air intakes and wall panels on the exterior of the building.
17. Consider consulting a structural engineer/architect specializing in building envelope issues to examine the drainage plane and the blockage of weep holes in the courtyard.
18. Seal areas around sinks to prevent water-damage to the interior of cabinets and adjacent wallboard. Inspect adjacent areas for water-damage and mold/mildew growth, repair/replace as necessary. Disinfect areas of microbial growth with an appropriate antimicrobial as needed.
19. Remove plants growing against the exterior wall/foundation of the building to prevent water penetration. Trim trees away from brickwork.
20. Clean and maintain aquariums and terrariums to prevent bacterial/mold growth.

21. Replace missing ceiling tiles to prevent the egress of dirt, dust and particulate matter into classrooms.

22. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.

23. Clean chalkboards and dry erase board trays regularly to avoid the build-up of particulates.

24. Change filters for window-mounted air conditioners and air-handling equipment as per the manufacturer's instructions or more frequently if needed. Vacuum interior of units prior to activation to prevent the aerosolization of dirt, dust and particulates. Ensure filters fit flush in their racks with no spaces in between allowing bypass of unfiltered air into the units.

25. Consider discontinuing the use of tennis balls on chairs to prevent latex dust generation.

26. Store cleaning products properly and out of reach of students.

27. Remove lab hood in teacher's workroom and install ceiling mounted exhaust grill.

28. Use the principles of integrated pest management (IPM) to rid the building of pests. A copy of the IPM recommendations can be obtained from the Massachusetts Department of Food and Agriculture (MDFA) website at the following website: http://www.state.ma.us/dfa/pesticides/publications/IPM_kit_for_bldg_mgrs.pdf.

29. Consider adopting the US EPA (2000) document, "Tools for Schools", in order to maintain a good indoor air quality environment on the building. The document can be downloaded from the Internet at http://www.epa.gov/iaq/schools/index.html.

30. For further building-wide evaluations and advice on maintaining public buildings, see the resource manual and other related indoor air quality documents located on the MDPH's website at http://www.state.ma.us/dph/beha/iaq/iaqhome.htm.

References

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL.

Burge, H.A. 1995. *Bioaerosols*. Lewis Publishing Company, Boca Raton, FL.

CPS. 2003. Cambridge Public Schools Elementary Consolidation Plan. Cambridge Public Schools. http://www.cps.ci.cambridge.ma.us/NewFiles/Fact Sheet-Consolidation.pdf

NIOSH. 1997. NIOSH Alert Preventing Allergic Reactions to Natural Rubber latex in the Workplace. National Institute for Occupational Safety and Health, Atlanta, GA.

NIOSH. 1998. Latex Allergy A Prevention. National Institute for Occupational Safety and Health, Atlanta, GA.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

Sanford. 1999. Material Safety Data Sheet (MSDS No: 198-17). Expo® Dry Erase Markers Bullet, Chisel, and Ultra Fine Tip. Sanford Corporation. Bellwood, IL.

SBAA. 2001. Latex In the Home And Community Updated Spring 2001. Spina Bifida Association of America, Washington, DC. Http://www.sbaa.org/html/sbaa_mlatex.html

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

US EPA. 1992. Indoor Biological Pollutants. US Environmental Protection Agency, Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, research Triangle Park, NC. EPA 600/8-91/202 January 1992.

US EPA. 2000. Tools for Schools. Office of Air and Radiation, Office of Radiation and Indoor Air, Indoor Environments Division (6609J). EPA 402-K-95-001, Second Edition. http://www.epa.gov/iaq/schools/tools4s2.html

Figure 2
The Function of the Drainage Plane and Weep Holes to Drain Water from the Wall System, Prevent Moisture Penetration into the Interior

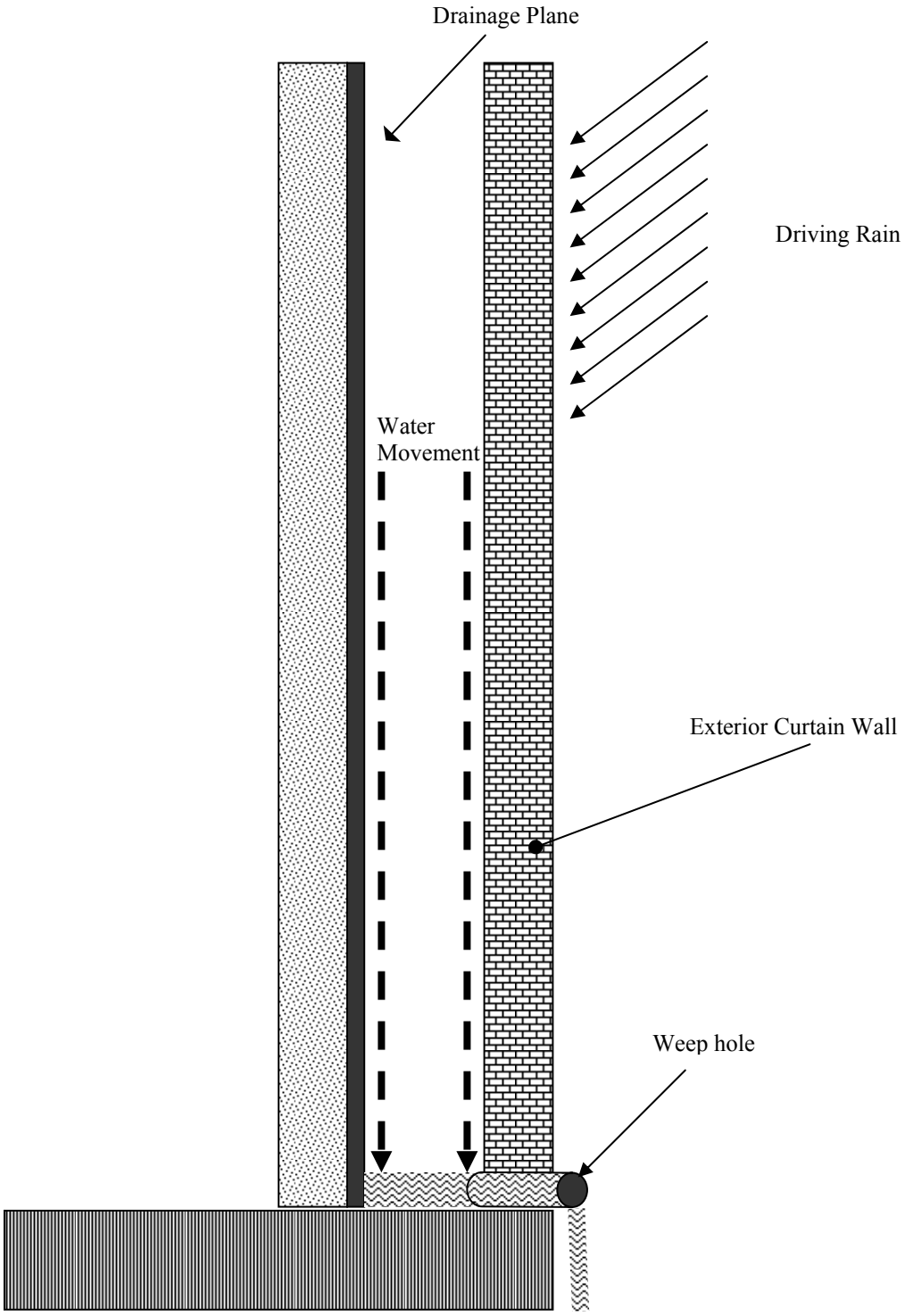
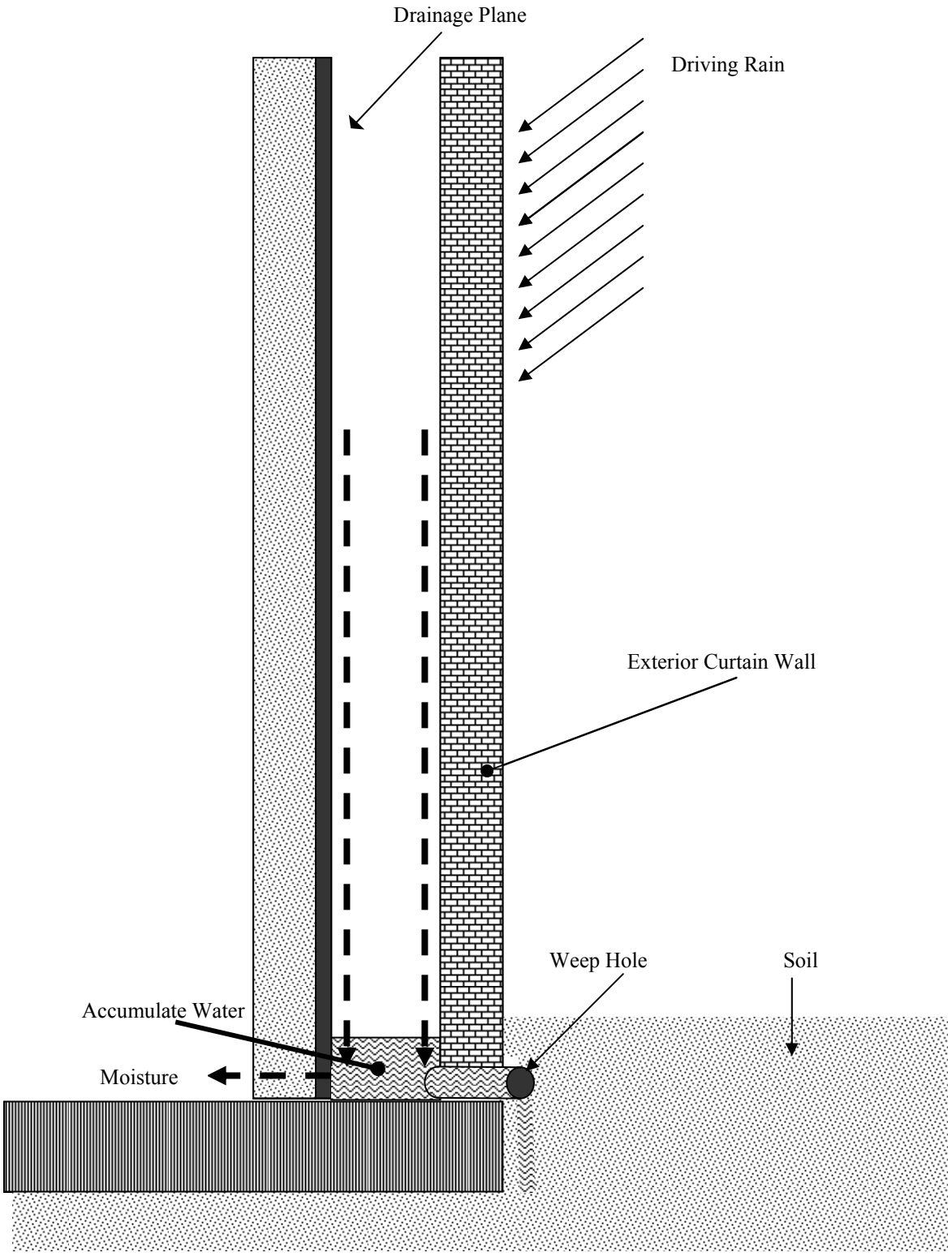


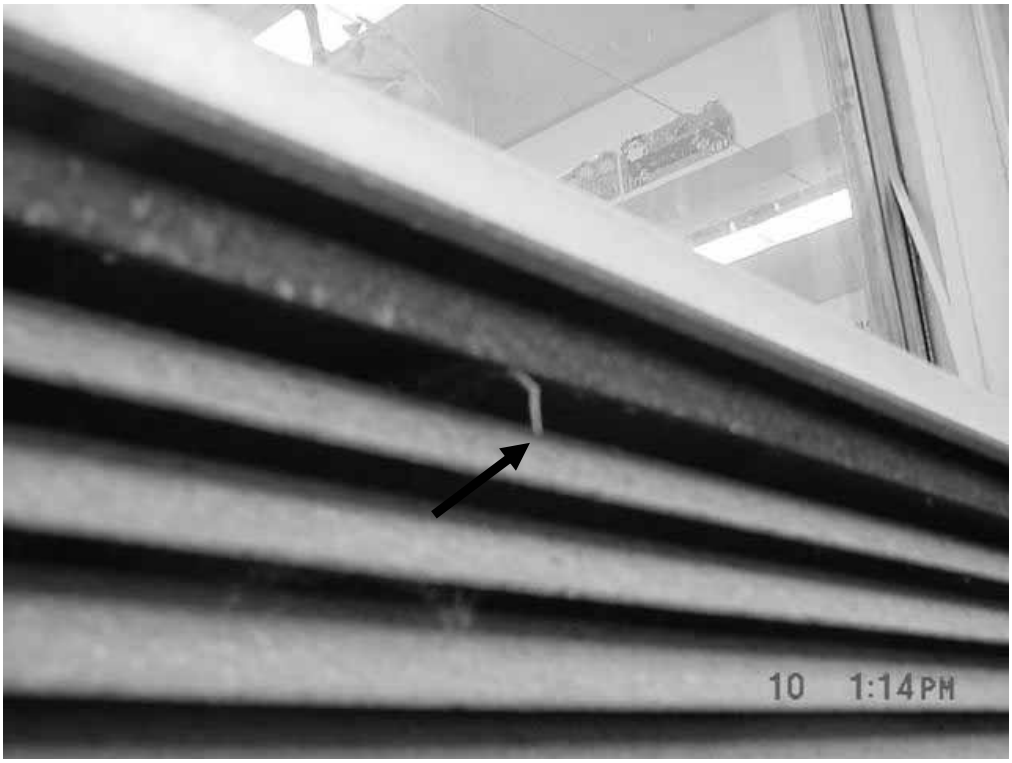
Figure 3
Weep Hole Blocked and Water Accumulation in the Drainage Plane



Picture 1

Classroom Unit Ventilator (Univent)

Picture 2



Univent Fresh Air Intake, Note Mouse Tail Hanging out of Intake Grill

Picture 3

Various Items on and in front of Classroom Univent Obstructing Airflow

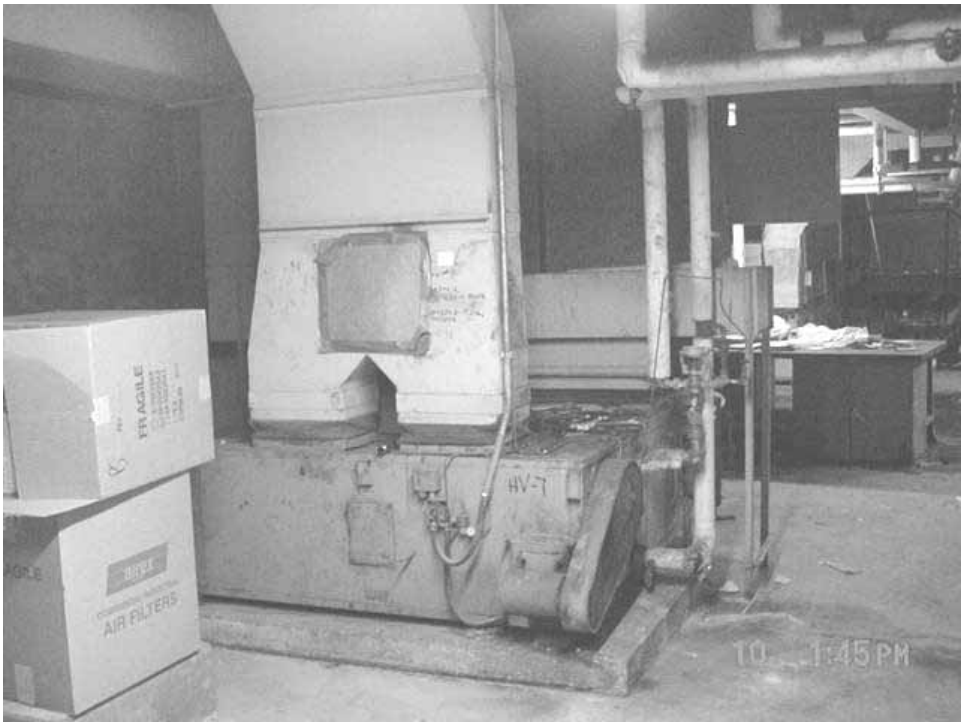
Picture 4

Exhaust Vent on Interior Wall of Coat Closet, Note how Vent is Blocked When Closet Door is Open

Picture 5

Classroom Coat Closets and Undercut Doors

Picture 6

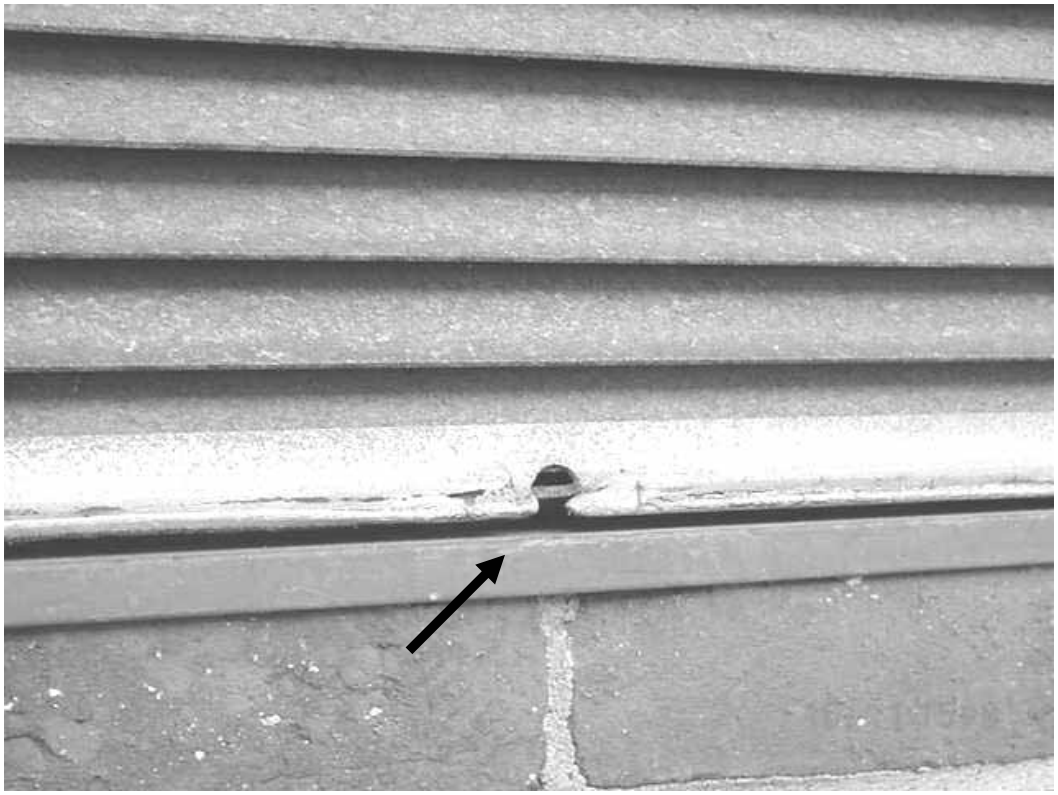


AHU Located in Boiler Room, Note Panel with Duct Tape

Picture 7

Terrarium with Rotting Food/Mold Growth in Library

Picture 8



Spaces around Univent Fresh Air Intake

Picture 9

Hole in Caulking Exterior Wall Panel Courtyard

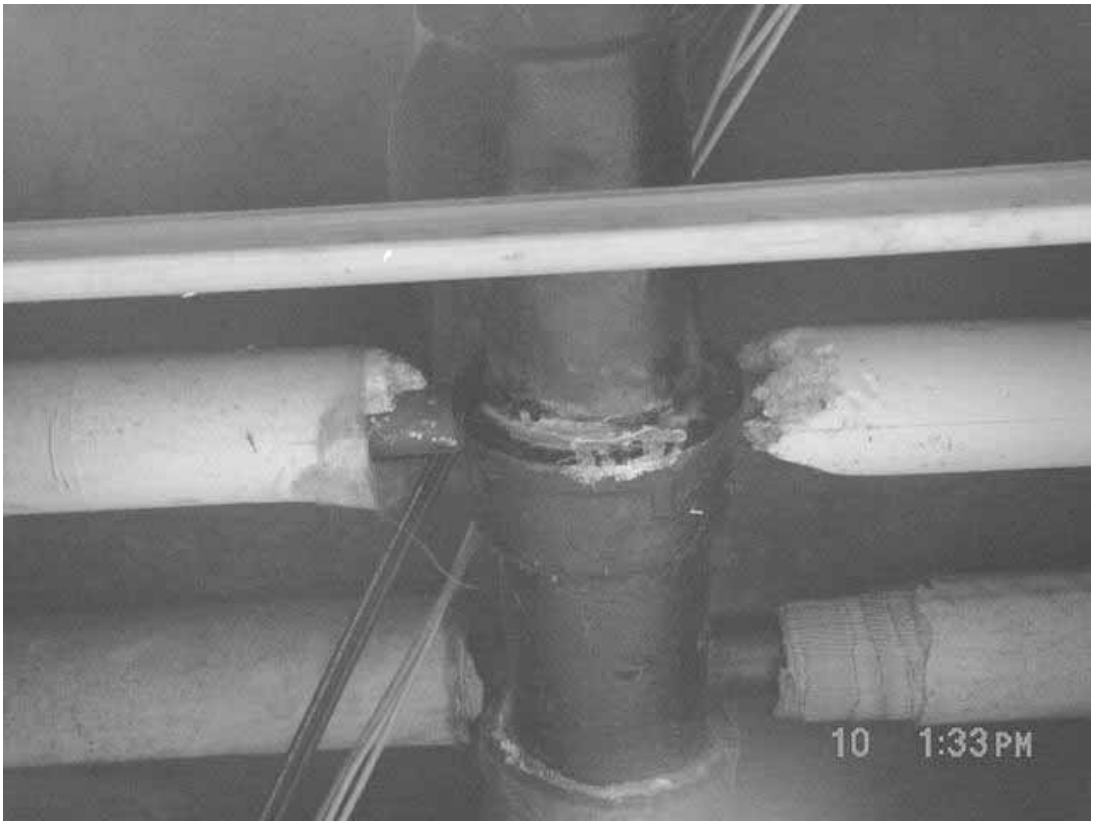
Picture 10

Sealing of Weep-Holes in Brick Walls of Courtyard

Picture 11

Tree in Courtyard in Close Proximity to Exterior Walls

Picture 12



Damaged/Exposed Pipe Insulation in Art Room

Picture 13

Damaged/Exposed Pipe Insulation in Room 18

Picture 14

Tennis Balls on Chair Legs in Classroom

Picture 15

Lab Hood in Teachers Workroom

Picture 16

Cleaning Products and Paint Stored Beneath Sink in Classroom

TABLE 1

Indoor Air Test Results – Peabody Elementary School, Cambridge, MA June 10, 2003

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Outside (Background)	375	70	48					
Room 18	759	74	47	11	Y	Y	Y	Window open, retrofitted AHU, not completed, window AC/Filter dirty, damaged pipe insulation material, dirt dust accumulation
Library	857	74	47	2	Y	Y	Y	Aquarium/terrariums-mold growth, UV off, birds/wasp nests, plants in standing water, possible mold growth in drip pans, exhaust obstructed, dirt/dust accumulation in UVs
Teachers Work Room	912	74	50	1	Y	Y	Y	Chemical hood used as local exhaust for photocopier/laminator
Room 20	1200	74		21	Y	N	N	Window/door open, chalk dust, UV obstructed with boxes, items hanging from CT
Room 21	1483	75	51	22	Y	Y	Y	Tennis balls
Gym	473	75	44	20	Y	Y	Y	

*** ppm = parts per million parts of air**
CT = ceiling tile MT = missing tile
DEM = dry erase markers

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

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Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Room 8	730	73	45	0	Y	Y	Y	Plants near UV
1st Floor Boys Room			47	--	N	Y	Y	Exhaust weak Supply passive
Room 9	722	74	47	20	Y	Y	Y	UV exhaust off, exterior door open Aquarium
Room 10	782	74	49	17	Y	Y	Y	Fur, plants Items on UV
Conference Room	662	72	47	0	Y	N	Y	Window AC Missing CT
Rest Room Main Office	700	73	49	0	N	N	Y	Main office
Principal's Office	704	73	49	5	Y	N	N	Dirt/dust accumulation on window sill
Main Office	794	74	49	8	Y	N	N	Plants Photocopiers
Court Yard								Ivy on walls, dead mouse in air intake, missing/damaged caulking around windows

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						Supply	Exhaust	
Cafeteria	652	75	41	60	N	Y	Y	Vent blocked and off
Art Room	536	76	40	3	Y	Y	Y	Window open, bleach, paint thinners on shelf – cabinets (wood), missing tiles, damaged counter top sink, exposed/damaged pipe insulation, items hanging from CT
Auditorium	506	77	42	20	N	Y	Y	Supply vent obstructed by curtain
Boiler Room								Standing water, drainage to sewer pipe, water-damaged wood, standing water dripping valves/ground water, water-damaged card board
Perimeter								Leaves debris in air intakes, caulking window panes, moss growth/spaces tarmac/skirt, wet bricks AC
Room 12	576	73	49	0	Y	Y	Y	Supply and exhaust off, 2 personal heaters, microwave, interior door open
Room 13	743	72	46	0	Y	Y	Y	Supply and exhaust off, door open, UV blocked, cleaners under sink

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Room 17	622	72	47	0	Y	Y	Y	UV blocked, chalk dust Interior door open
Room 16	722	72	49	0	Y	Y	Y	Supply and exhaust off, door open Hot plates, cleaners, clutter
Room 15	672	72	49	0	Y	Y	Y	Supply and exhaust off, potting soil, cleaners, chalk dust, UV blocked, door open
Room 15 Storage	725	73	49	0	Y	N	N	Microwave, clutter, mousetrap out in open, has food
Science Room	474	72	45	0	Y	Y	Y	chalk dust, aquarium, UV completely blocked, clutter, plants, DEM
Room 25	670	75	44	14	Y	Y	Y	Supply and exhaust off Cleaners
Room 24	850	74	42	17	Y	Y	Y	Supply and exhaust off/blocked exhaust UV blocked
Room 23	763	74	43	11	Y	Y	Y	Supply and exhaust off, UV blocked, cleaners/sink, branches in front of window
Teacher's Lounge	659	74	43	0	Y		N	Sink, cooking range, broken tile

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Teacher's Lounge Rest Room				0	N		Y	Exhaust on
Girls Rest Room				0	N		Y	Passive supply on wall, drain partially clogged with dust, wet trap
Room 8	890	74	48	0	Y	Y	Y	Supply and exhaust off, plants by UV chalk dust, DEM
Room 3	544	74	42	20	Y	Y	Y	Exhaust off, cleaners, plants hanging (dry), tennis balls, plants on UV-blocked
Room 2-A	535	74	41	0	Y	Y	N	Supply off-blocked, plant material on vent, clutter, DEM
Room 2-B	540	74	42	1	Y	Y	Y	Portable AC, exterior door open, chalk dust, cleaners, items hanging from ceiling
Room 4	1380	72	51	0	Y	Y	Y	Supply off, UV blocked, plants on UV, odors - cleaners, planting material,
Room 5	820	73	47	0	Y	Y	Y	Exhaust off, plants on UV, materials hanging on ceiling
Room 1	810	731	48	0	Y	Y	Y	Supply and exhaust off, tennis balls, materials hanging from ceiling, UV blocked
Room 1-A	638	73	45	2	Y	N	N	

*** ppm = parts per million parts of air**
CT = ceiling tile MT = missing tile
DEM = dry erase markers

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 1

Indoor Air Test Results – Peabody Elementary School, Cambridge, MA June 10, 2003

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Music Room	887	72	49	0	Y	Y	N	UV blocked, MT, door open Supply off
Health Suite	729	72	47	0	Y	N	N	Door open PT
Health 1	745	72	48	0	Y	N	N	
Health 3-A	807	72	49	0	N	N	N	Tennis balls
Health Rest Rooms							Y	Strong exhaust
Health 3-B	1298	73	51	2	Y	N	N	
Health 2	1200	73	50	0	Y	N	N	
Boiler Room Stairway								Doors to second floor open

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